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THE INTRODUCTION, RELEASE, AND RECOVERY OF PARASITES OF THE ALFALFA WEEVIL IN EASTERN UNITED STATES

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CONTENTS

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THE INTRODUCTION, RELEASE, AND RECOVERY OF PARASITES OF THE ALFALFA WEEVIL IN EASTERN UNITED STATES

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The alfalfa weevil, *Hypera postica* (Gyllenhal), was discovered in Eastern United States in 1951, and since that time it has spread into 29 States east of longitude 96° W. Release of introduced parasites of this pest in the East was initiated by the Insect Indentification and Parasite Introduction Research Branch in 1957. In cooperation with the Grain and Forage Insects Research Branch and research workers in the various States, more than 300 releases have been made of 10 species of parasites on alfalfa weevil in 20 States. Information is presented in this publication regarding the localities where the different species of parasites were released each year through 1967, their life histories so far as they are known, methods for the recovery of parasites from release sites, rearing the alfalfa weevil stages and parasites in the laboratory, and methods for releasing parasites.

ESTABLISHED PARASITES

Bathyplectes curculionis (Thomson) (Ichneumonidae).—*B. curculionis* has been released in and recovered from most of the Eastern States in which the alfalfa weevil has been established for several years. It has one complete brood and a partial second brood each year. In New Jersey and Pennsylvania, the first brood begins about 4 weeks before the peak abundance of alfalfa weevil larvae in fields (when alfalfa plants are about 10 to 15 cm. high in New Jersey), and the second brood begins about 1 to 2 weeks after the peak of larvae abundance.

B. curculionis parasitizes first- and second-instar larvae mostly, and the parasite forms its cocoon in the cocoon formed by the host larva before it is is killed by the parasite larva. The cocoon of *B. curculionis* is dark mahogany in color, 3 to 4 mm. long and about 2 mm. in diameter with a cream-colored band around the cocoon midsection that looks as though it were paint that had been applied with a small brush. Some of the first-brood parasite larvae transform to adults and give rise to a partial second brood. All of the second brood parasites and the nontransforming portion of the first brood overwinter as larvae in cocoons on the ground. This parasite is recoverable during its first or second brood by rearing in the laboratory weevil larvae taken in the field with insect sweep nets, and by sweeping the adult parasites from alfalfa plants in the field. The rate with which weevil larvae are parasitized varies from field to field, but 70 percent or more have been found to be parasitized in some fields in New Jersey 10 to 15 days after the peak of weevil larvae population.

Bathyplectes anurus (Thomson) (Ichneumonidae).—*B. anurus* is known to be firmly established in Pennsylvania and New Jersey. It has only one brood each year, and adults that have emerged from overwintering cocoons appear in the field at about the same time as *B. curculionis*. It parasitizes first- and second-instar weevil larvae mostly, forms its cocoon in the cocoon formed by the host larvae before it is killed by the parasite, and the cocoons drop to the ground where they can be found in plant debris. The cocoon of *B. anurus* is dark mahogany, 3 to 4 mm. in length, about 2 mm. in diameter, and contains a narrow white to cream-colored stripe around the cocoon midsection, which is slightly raised and appears to be an integral part of the cocoon. The parasite larva is capable of causing its cocoon to jump 3 to 4 inches high. In late September and October (in Pennsylvania and New Jersey), the parasite larvae transform to diapausing adults in which stage they overwinter in the cocoon. About 30 percent of sizable collections of weevil larvae taken from fields near release sites have produced *B. anurus*. The rate of parasitism is expected to be considerably greater than that observed to date after the parasite reaches maximum abundance in large areas. *B. anurus* can be

[1] Presently located at Insect Identification and Parasite Introduction Research Branch, European Parasite Laboratory, Gif-sur-Yvette, France.

recovered by rearing in the laboratory weevil larvae collected from release site fields when the larvae are most abundant.

Microctonus aethiops (Nees) (Braconidae).—*M. aethiops* is firmly established in about 100 square miles of area in New Jersey which includes Moorestown, Burlington, and Mount Holly. It has two broods each year and parasitizes only the adult weevils. About the time that alfalfa plants begin their annual growth, the overwintering parasite larvae complete their development, emerge from the host weevil, and form small, nondescript gray cocoons in the plant debris on the ground. Soon afterward, the adult parasites emerge and produce a brood on the nonparasitized overwintering weevils still present in the field. The parasite completes development without diapause in the overwintered (sexually mature and laying eggs) weevils. The adult parasites emerge 2 to 3 weeks later and parasitize the new brood of weevils. This parasitizing occurs during early June in New Jersey and about 2 weeks after the peak of weevil larvae abundance. The new brood of weevils diapause until the next year, and in these, *M. aethiops* overwinters, in diapause, as first-instar larvae.

M. aethiops can best be recovered by rearing in the laboratory overwintered weevils collected from fields during the time of peak abundance of weevil larvae and shortly thereafter. Collections should be obtained for rearing before the newly transformed (new brood) weevils become abundant because of the difficulty in separating them from the overwintering weevils. (Newly eclosed weevils are lighter in color than overwintered weevils.) In the area in New Jersey where this parasite is well established, 50 to 70 percent of the overwintered weevils collected as described above are parasitized by *Microctonus*. The parasite can also be recovered from weevils collected from fields during late fall and early winter, and in debris from alfalfa fields during the winter months.

The presence of *Microctonus* larvae in weevils can be detected by dissection under water. The parasite larva is usually found in the posterior part of the host abdomen from which it usually floats during dissection. The haemolymph of most parasitized weevils contain numerous teratocytes.[2] The readily visible teratocytes (floating flecks of gray matter) aid in detecting the presence of a *Microctonus* larvae, but they are not an infallible indicator as some parasitized weevils do not contain them. Fifteen to thirty-five percent of the first-brood weevils collected (and dissected) from fields in June in New Jersey 2 to 3 weeks after peak abundance of weevil larvae and during October and November have been found to be parasitized by *Microctonus*. First-brood weevils collected from fields during the spring, about 2 weeks after peak abundance of weevil larvae, will yield some parasites (at 75° F.) after storage at 45° F. (constant temperature) for 3 to 4 months, but most of the parasites remain in diapause in the weevils when treated in this manner. Some parasites will emerge from weevils immediately after collection from fields during late fall, and more will emerge after storage as described immediately above; however, many of the parasites remain in diapause.

Sexually mature female weevils cease oviposition almost immediately after parasitization by *M. aethiops*. The reproductive organs of parasitized first-brood weevils do not develop normally, and the parasitized weevils do not reproduce.

Microctonus sp. "Domestic Black" (Braconidae).—No record of this undescribed species appears in entomological literature prior to the time that the alfalfa weevil was discovered in the East; therefore, it is possible that this parasite was present in the weevils introduced originally. The parasite is fairly abundant in New Jersey, eastern Pennsylvania, and northern Delaware, and it has been recovered in Maryland, North Carolina, and Connecticut. It is probably present in other Eastern States, but has not been recovered by State workers probably because adults are not easily collected, and cannot be reared readily in the laboratory from field-collected weevils. We think that this parasite is being dispersed in the East within the migrating weevils that fly from one area to another in search of hibernating quarters.

The female of this parasite is black (*M. aethiops* is reddish), reproduces parthenogenetically, and parasitizes large-size weevil larvae. The parasite larva completes development in and emerges from the host weevil and forms a nondescript gray cocoon on the ground debris. It has one generation each year. Adult parasites appear in the field when weevil larvae are abundant. The parasite overwinter as diapausing first-instar larvae in the diapausing new brood of weevils. The parasite can be recovered from overwintering weevils collected in plant debris from alfalfa fields during late winter or early spring. Some emergence may be obtained from overwintering weevils swept from alfalfa fields during early spring soon after the growing season begins. Weevils swept from alfalfa fields during late fall will yield some parasites after they have been stored at 45° F. for 2 to 3 months. Regardless of the time that weevils are collected to recover this parasite, under laboratory conditions a large part of the parasite larvae in the weevils remain in diapause although the host may become active, feed, and appear to have broken diapause. Practically no parasites are obtained from new-brood weevils collected during late spring or early

[2] Loan, Conrad. 1961. INTRODUCTION OF EUROPEAN PARASITES OF SITONA SPP. FOR CONTROL OF THE SWEETCLOVER WEEVIL, SITONA CYLINDRICOLLIS, IN CANADA. Jour. Econ. Ent. 54(5) : 1026–31.

summer and placed in constant temperature cold storage (35° to 45° F.) for 3 to 6 months to break diapause.

In general, the rate of parasitization has been low and varies from field to field. The possible capability of the species has been indicated by the fact that about 40 percent of the weevil larvae collected from some fields have been parasitized (determined by dissection). No dependable external body character has been discovered thus far that can be used to distinguish the larvae of *Microctonus* sp. "Domestic Black" from *M. aethiops.*

Tetrastichus incertus Ratzburg (Eulophidae).—*T. incertus* is known to occur throughout New Jersey, northern half of Delaware, eastern half of Pennsylvania, part of Maryland, southeastern New York, in Kentucky, West Virginia, Massachusetts, Connecticut, Vermont, and New Hampshire. It parasitizes mostly third- and fourth-instar weevil larvae, which, after forming their cocoons and succumbing to the parasite, take on a mummified appearance and are dark brown to mahogany. The number of adult parasites produced per host mummy vary, but about five is the usual number. There are several generations of the parasite each year. It diapauses and overwinters in the host larvae mummies.

T. incertus does not become abundant in fields in New Jersey and Pennsylvania before mid-June. The beneficial value of the parasite in reducing the weevil population in these States depends upon the affect that the weevil larvae occurring in fields during the summer and fall months have on the overwintering population of weevils. During the summer and fall months of some years, alfalfa weevil larvae appear in destructive numbers in some fields in the Northeastern States, but they are usually scarce in these States during dry seasons. Parasitization by *T. incertus* averaged 71 percent among several thousand weevil larvae in more than a hundred periodic collections obtained from several fields in eastern Pennsylvania during the summer and fall months of 1964 and 1965.

PARASITES RELEASED BUT NOT RECOVERED

Bathyplectes sp. "Bagged".—Only small numbers of *Bathyplectes* sp. have been released in this country to date. Definite attempts will be made to obtain this undescribed species from Europe in large numbers for release in the future. Presumably, *Bathyplectes* has only one brood each year and parasitizes first- and second-instar weevil larvae. Fully developed larvae of the parasite emerge from the host larvae (before the host larvae form their cocoons), drop to the ground, and form double cocoons. The outer cocoon resembles a silken capsule which encloses the inner cocoon in which the parasite overwinters as a larvae. It is suspected that the species could best be recovered from release sites by collecting and rearing weevil larvae when the host is most abundant in the field.

Peridesmia discus (Walker) (Pteromalidae).—*P. discus* was obtained from southern France for shipment to this country for release. It is found in its native habitat feeding on the eggs of the alfalfa weevil in old alfalfa stems during the winter months. The life history of the parasite is not known. It is suspected, however, that the alfalfa weevil serves as an alternate host on which the egg predator overwinters. Presumably, *P. discus* could be recovered in the same manner that it is obtained in France for shipment to this country. This is by collecting, during the winter months, old alfalfa stems containing weevil eggs. The stems are placed in emergence cages in a room in which the temperature is maintained at 22° C. If present, the adult parasites begin to emerge within a week and may be collected over a period of 3 weeks.

Trichomalus inops (Walker) (Pteromalidae).—The parasite larvae of *T. inops* feed on the eggs of the alfalfa weevil in alfalfa stems. The material shipped to this country for release was obtained in southern France from old alfalfa stems collected in fields during the winter months. Presumably, recovery methods would be the same as for *P. discus.*

Dibrachoides druso (Walker) (Pteromalidae).—In France, *D. druso* has two generations per year on the alfalfa weevil, and it attacks the prepupa and pupa stages. About four adult parasites are produced from several eggs placed on each host. In attempt at recovery of this species, cocoons of the alfalfa weevil should be collected from plants in the field, and they should be held in the laboratory at about 22° C. for emergence of the parasite.

Campogaster exigua (Meigen) (Tachinidae).—This European species parasitizes and develops in the adult weevil. Information on its life history is incomplete. In attempting recovery, weevils should be collected and held in the laboratory at about 22° C. for emergence of the parasite. (Note: *D. druso* and *C. exigua* are introduced species, not native.)

NATIVE PARASITES REARED FROM ALFALFA WEEVILS IN EASTERN UNITED STATES

Patasson luna (Girault) (Mymaridae).—The egg of *P. luna* is deposited inside the egg of the alfalfa weevil. The parasite egg has been reared from alfalfa stems containing weevil eggs collected in fields during the winter months. About 10 percent of the eggs in some fields have been parasitized. This species is treated here as native though it is known to have been imported from Italy and released in Utah during the years 1911–13 and 1925–28. Possibly because of confusion with *Anaphes pratensis* (Foerster), which was present in the same material, it is not known whether *P. luna* was established as a result of these early introductions. *A. pratensis* was recovered in 1926 and again in 1929–31. In 1928 it was shipped from Utah to Indiana for release against *Hypera nigrirostris* (F.), the lessor clover leaf weevil. *P. luna* might have been included in that material.

Hyaolmyodes triangulifera (Loew) (Tachinidae).—*H. triangulifera* has been reared from adult weevils collected in the field during the winter months. Recovery has been infrequent, but about 5 percent of the weevils in samples from some fields have been parasitized.

Spilochalcis albifrons (Walsh) (Chalcidae) and *Pediobius* sp. (Eulophidae) have been reared occasionally from alfalfa weevil pupae. Other adventitious parasites of weevil stages will, without doubt, be reared from different stages of the weevil in the future.

RELEASE OF ALFALFA WEEVIL PARASITES

The shipping container used mostly by the Agricultural Research Service, Moorestown, N.J., is a fabricated 1-pint, cylindrical, cardboard food container which provides food (honey), water, humidity, and a small amount of wood excelsior on which the parasites can rest. Both male and female parasites are usually included in shipments. Parasites should be released in fields that have not been treated with insecticide, and where no such treatments will be applied for 3 to 4 weeks following a release. Releases should be made near the central part of the field and the parasite container should be placed on the ground near the base of an alfalfa plant with the lid partly removed to provide an opening about one-half to three-fourths of an inch wide. A few branches of alfalfa plant or ground debris should then be placed over the container so that the parasites will encounter a barrier on which they must alight when they escape the container. Mating may be encouraged and rapid dispersal reduced if handled in this manner. Within a few minutes after the container had been opened most of the parasites will have emerged. The number of dead parasites and sex can then be recorded.

REARING FIELD-COLLECTED STAGES OF THE ALFALFA WEEVIL AND PARASITES

Many different kinds of containers can be used in the laboratory to rear the different stages of the alfalfa weevil and the parasites they contain. The basic containers used at the Moorestown laboratory are described below.

Cardboard Cartons.—The half-pint, paraffin impregnated, cylindrical, cardboard food carton (approximately 8.5 cm. in diameter and 5 cm. high) covered with one-half of a glass petri dish is used in rearing small lots of 25 to 100 weevil larvae or adults. Bouquets of growing alfalfa stems in 1.5 × 5 cm. straight-sided glass vials filled with water and stoppered with wet cotton provide food for the weevil stages. Half-gallon cylindrical food cartons are used in rearing lots of 100 to 500 larvae. The diameter of the carton is approximately 17 cm. and the height is 11 cm. Two openings, about 8 × 5 cm., cut from opposite sides of the carton and covered with dacron, nylon, or cotton organdy cloth, provide the ventilation needed in this size carton. The carton is covered with an inverted glass pie plate, approximately 21.5 cm. in diameter and 3 cm. deep. Bouquets of alfalfa stems, in 2.4- × 7.5-cm. glass vials filled with water and stoppered with wet cotton, provide food and water for the weevil stages being reared.

The cartons described above are also used to obtain parasitization in the laboratory of weevil stages by different species of parasites, to obtain weevil eggs in alfalfa stems, and to rear weevil larvae and adults for use in experimental work.

Plastic Container.—Parasites such as *Microctonus* spp. that complete development in and emerge as full-grown larvae from the adult stage of the alfalfa weevil, respond favorably to a cage containing a 14- to 17-mesh screen false bottom.

The parasite larvae upon emerging from the host adult pass through the false bottom, drop to the bottom of the cage, and form cocoons on the surface of black felt strips 2 to 3 cm. wide (sections of the felt can be separated into 2 to 3 strips) that lie flat on paper toweling on the cage bottom. The diameter of the top of the plastic container [3] used at Moorestown is 13.5 cm.; the width at the bottom is 12 cm. and the height is 13.5 cm. A section 1.5 cm. deep is cut from the lower part of the container and a circular opening 10 cm. in diamter is removed from the bottom of this piece. A 14- x 17-mesh plastic screen is glued over the opening. This part is placed inside the container to form the false cage bottom. A circular opening 10 cm. in diameter is cut from the plastic lid, and over this opening a 42-mesh plastic screen, or dacron, nylon, or cotton organdy cloth is glued. This assembly is placed on an unaltered plastic lid turned upside down to contain the parasite larvae that pass through the false bottom. The plastic cage is also used to expose stages of the weevil to parasites.

Other types of containers that have been used at Moorestown are glass battery jars (15 cm. in diameter and 21 cm. high) closed with organdy or muslin cloth and a rubberband; 1-gallon glass jars, flat on four sides, and with a metal screw lid 12 cm. in diameter (circular opening cut from lid 10 cm. in diameter over which 42-mesh plastic screen or organdy cloth is glued); and organdy-cloth covered wood frame cages 30 cm. wide, 45 cm. deep, and sufficiently high to accommodate potted alfalfa plants, with a tight fitting door of glass or plastic.

PARASITE RELEASE LOCALITIES

The following tabulation gives the States, counties, and localities where parasites of the alfalfa weevil have been released in Eastern States through 1967. We do not have information on the county and locality where a few colonies were released. Workers in some States have collected and subcolonized certain species of alfalfa weevil parasites within their States to increase the parasite dispersal rate. This procedure is highly recommended because it will hasten the buildup of the parasite population throughout sizable areas to a level sufficient for the parasites to begin suppressing the alfalfa weevil population.

Information is meager on the establishment of the parasites in the different localities listed. Hopefully, the information presented herein will stimulate interest in recovery of the various species that have been released and in their subcolonization within the States. The parasites recovered can be sent for identification to the Insect Identification and Parasite Introduction Research Branch, Entomology Research Division, Plant Industry Station, Beltsville, Md. 20705.

[3] This container, 5⅛ inches in diameter and 5⅛ inches deep, is probably obtainable from most large manufacturers of plastic products.

Parasite release localities in Eastern United States, 1957–67

Species released, year, and State		County	Locality
Bathyplectes anurus			
1960	New Jersey	Burlington	Pemberton.
1963	New Jersey	do	Mount Holly.
	Pennsylvania	Lancaster	Bowmansville.
1964	New Jersey	Monmouth	Allentown.
	Pennsylvania	Chester	Atglen.
1965	Delaware	New Castle	Newark.
	Indiana	Harrison	Corydon.
	Missouri	Reynolds	Garwood.
	Ohio	Franklin	Columbus.
		Wayne	Wooster.
1966	New Jersey	Burlington	Medford.
	Pennsylvania	Chester	Oxford.
1967	Delaware	Kent	Dover.
		New Castle	St. George.
	Illinois	Pope	Robbs.
	Indiana	Tippecanoe	Lafayette.
	Kentucky	Fayette	Lexington.
	Maryland	Howard	Clarksville.
	Massachusetts	Hampshire	Northampton.
	New Hampshire	Hillsboro	Nashua.
	Tennessee	Knox	Knoxville.
	Virginia	Montgomery	Blacksburg.

Parasite release localities in Eastern United States, 1957–67—Continued

Species released, year, and State		County	Locality
Bathyplectes curculionis			
1959	Delaware	Kent	Dover.
		do	Smyrna.
		New Castle	Middletown.
	New Jersey	Burlington	Columbus.
		do	Medford.
		do	Mount Holly.
		do	Rancocas.
	Virginia	Accomack	Onancock.
1960	New Jersey	Burlington	Pemberton.
		do	Rancocas.
		Hunterdon	Ringoes.
1961	New Jersey	Warren	Blairstown.
	North Carolina	Wake	Raleigh.
	Pennsylvania	Chester	Oxford.
		Lebanon	Lebanon.
	Virginia	Montgomery	Blacksburg.
		Roanoke	Roanoke.
1962	Georgia	Clarke	Athens.
	Massachusetts	Bristol	Seekonk.
		Franklin	?
		Hampshire	Amherst.
		Franklin	Leverett.
	New Jersey	Monmouth	Allentown.
		Salem	Sharptown.
		Somerset	Belle Meade.
		Warren	Blairstown.
		do	Vail.
	New York	Dutchess	Fishkill.
	Ohio	Wayne	Wooster.
	Pennsylvania	Centre	State College.
	Tennessee	Knox	Knoxville.
	West Virginia	Monongalia	Morgantown.
1963	Maryland	Prince Georges	Beltsville.
	New York	Columbia	Ghent.
	Ohio	Wayne	Wooster.
	Tennessee	Knox	Knoxville.
		Blount	?
		Greene	?
	Pennsylvania	Chester	Oxford.
1964	Kentucky	Lincoln	?
		Pulaski	?
		Todd	?
1965	New York	Tioga	Nichols.
		Tompkins	Ithaca.
	Ohio	Franklin	Columbus.
		Highland	Smantha.
	Vermont	Bennington	South Shaftsbury.
1966	Indiana	Harrison	Corydon.
	Maryland	Frederick	Frederick.
		do	Woodsboro.
		Prince Georges	Beltsville.
		Carroll	Tyrone.
	New Hampshire	Merrimack	Concord.
		Strafford	Durham.
		Sullivan	Charlestown.
		do	Langdon.
	Vermont	Chittenden	Hinesburg.
1967	Indiana	Tippecanoe	Lafayette.
	Vermont	Addison	Ferrisburg.
Bathyplectes n. sp.			
1964	Pennsylvania	Lancaster	Christiana.
1967	New Jersey	Burlington	Moorestown.
Campogaster exigua			
1957	Delaware	New Castle	St. George.
	New Jersey	Burlington	Moorestown.
		do	Mount Holly.

Parasite release localities in Eastern United States, 1957–67—Continued

Species released, year, and State	County	Locality
Dibracoides druso		
1959 New Jersey	Burlington	Mount Holly.
	do	Rancocas.
1960 New Jersey	Hunterdon	Ringoes.
	Warren	Blairstown.
1961 New Jersey	do	Do.
	do	Johnsonburg.
	do	Vail.
Pennsylvania	Centre	State College.
Virginia	Montgomery	Blacksburg.
West Virginia	Monongalia	Morgantown.
1962 Georgia	Clarke	Athens.
Massachusetts	Hampshire	Amherst.
New Jersey	Hunterdon	Flemington.
	Mercer	Pennington.
	Somerset	Belle Meade.
	Warren	Blairstown.
1963 New Jersey	Burlington	Mount Holly.
North Carolina	Wake	Raleigh.
1964 Massachusetts	Hampshire	Amherst.
Missouri	Mississippi	?
New Jersey	Burlington	Moorestown.
New York	Tioga	?
Pennsylvania	Lancaster	Christiana.
Microctonus aethiops		
1957 New Jersey	Burlington	Columbus.
1958 New Jersey	do	Mount Holly.
1959 New Jersey	do	Do.
	do	Rancocas.
1960 New Jersey	do	Columbus.
	do	Rancocas.
	Hunterdon	Ringoes.
1962 New Jersey	Somerset	Belle Meade.
	Warren	Vail.
1963 North Carolina	Wake	Raleigh.
1964 Kentucky	Fayette	Lexington.
Pennsylvania	Lancaster	Christiana.
1965 Illinois	Johnson	Vienna.
Indiana	Floyd	New Albany.
Maryland	Prince Georges	Beltsville.
Massachusetts	Hampshire	North Amherst.
New Jersey	Hunterdon	Stockton.
	Passaic	Clifton.
Ohio	Meigs	Carpenter.
Pennsylvania	Centre	State College.
	Cumberland	Boiling Springs.
	Dauphin	Hershey.
	Lancaster	Lancaster.
Vermont	Addison	Orwell.
Virginia	Montgomery	Blacksburg.
1966 Arkansas	Mississippi	Keiser.
Illinois	Clark	Casey.
	Coles	Lerna.
	Cumberland	Neoga.
Indiana	DuBois	?
	Tippecanoe	Lafayette.
Maryland	Middlesex	Concord.
	Prince Georges	Beltsville.
New Hampshire	Merrimack	Webster.
	Strafford	Durham.
New York	Tioga	Nichols.
North Carolina	Rowan	Salisbury.
Pennsylvania	Chester	Oxford.
	do	Steelville.
Tennessee	Knox	Knoxville.
	Marshall	Lewisburg.
Vermont	Addison	Shoreham.
1967 Arkansas	Craighead	Monette.

Parasite release localities in Eastern United States, 1957–67—Continued

Species released, year, and State	County	Locality
Microctonus aethiops—Continued		
1967 Delaware	Kent	Little Creek.
Illinois	Crawford	Palestine.
	Gallatin	Equality.
Indiana	Harrison	Laconia.
	Tippecanoe	Lafayette.
Massachusetts	Franklin	Deerfield.
Missouri	Cape Girardeau	Gordonville.
New Jersey	Warren	Blairstown.
New Hampshire	Grafton	Enfield.
Vermont	Addison	Ferrisburg.
Virginia	Montgomery	Blacksburg.
Microctonus n. sp.		
1967 Illinois	Champaign	Ivesdale.
	Douglas	Camargo.
	Washington	New Minden.
Indiana	Boone	Darlington.
	---do---	Thorntown.
	Montgomery	Waynetown.
Peridesmia discus		
1959 Delaware	Kent	Dover.
	---do---	Smyrna.
	New Castle	Middletown.
New Jersey	Burlington	Columbus.
	---do---	Medford.
Virginia	Accomack	Onancock.
1960 Delaware	Kent	Dover.
Maryland	Howard	Clarksville.
New Jersey	Burlington	Mount Holly.
1961 Pennsylvania	Chester	Oxford.
1966 Arkansas	Mississippi	Keiser.
North Carolina	Rowan	Salisbury.
	Wake	Raleigh.
Tennessee	Marshall	Lewisburg.
	Robertson	Springfield.
1967 Arkansas	Craighead	Monette.
	Mississippi	Blytheville.
	---do---	Yarbro.
North Carolina	Wake	Raleigh.
	---do---	Wake Forest.
Tennessee	Knox	Knoxville.
Tetrastichus incertus [1]		
1960 New Jersey	Warren	Blairstown.
	---do---	Marksboro.
	---do---	Vail.
1961 New Jersey	Burlington	Mount Holly.
	---do---	Rancocas.
	Warren	Blairstown.
	---do---	Johnsonburg.
North Carolina	Wake	Raleigh.
Pennsylvania	Centre	State College.
	Chester	Oxford.
Virginia	Montgomery	Blacksburg.
West Virginia	Greenbrier	?
	Monroe	?
1962 Massachusetts	Hampshire	Amherst.
New Jersey	Hunterdon	Flemington.
	Mercer	Pennington.
	Somerset	Belle Meade.
	Warren	Vail.
Pennsylvania	Centre	State College.
1963 New Jersey	Burlington	Columbus.
	---do---	Mount Holly.
Tennessee	Blount	?

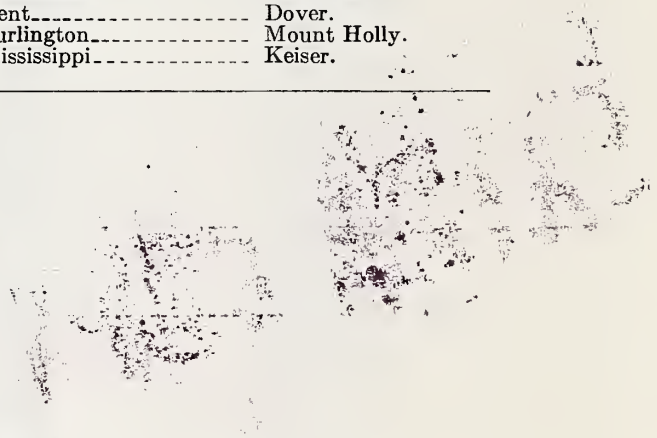
[1] *Tetrastichus incertus* is known to occur throughout New Jersey, northern Delaware, eastern Pennsylvania, part of Maryland, southeastern New York, and it is established in Kentucky, West Virginia, Vermont, New Hampshire, Massachusetts and Connecticut. Release sites within the area of its dispersal and States in which it is established are not included in this list.

Parasite release localities in Eastern United States, 1957–67—Continued

Species released, year, and State		County	Locality
Tetrastichus incertus—Continued			
1964	New Jersey	Burlington	Moorestown.
	New York	Tioga	Nichols.
	Kentucky	Lincoln	?
		Pulaski	?
	Missouri	Mississippi	Keiser.
1965	Illinois	Coles	Fox Ridge State Park.
		Edwards	Albion.
		Effingham	Watson.
		Jasper	St. Marie.
		Jefferson	Texico.
		Saline	Galatia.
	Indiana	Harrison	Corydon.
	Missouri	Cape Girardeau	Gordonville.
		Carter	Fremont
		New Madrid	Sikeston.
		Pemiscot	Steele.
		Reynolds	Garwood.
	New York	Tioga	?
		Tompkins	?
	North Carolina	Wake	Raleigh.
	Ohio	Butler	Le Sourdesville.
		Clark	Yellow Springs.
		Franklin	Columbus.
		Greene	Yellow Springs.
		Mahoning	Canfield.
		Medina	Seaville.
		Pickway	Pherson.
		do	Ringold.
		Wayne	Burbank.
		do	Wooster.
	Vermont	Windham	Brookline.
		do	Newfane.
		do	Putney.
		do	Rockingham.
1966	Illinois	Bond	Donnellson.
		Edwards	Albion.
		Fayette	Vandalia.
		Gallatin	Equality.
		Jackson	Grinsby.
		Madison	Alhambra.
		do	Fayetteville.
		Randolph	Sparta.
		White	Brownville.
	Indiana	Harrison	Corydon.
		Jackson	Brownstone.
		Johnson	Samaria.
		Ripley	Ballston.
		do	Osgood.
	Ohio	Carrol	Bergholz.
		Columbiana	Lisbon.
		Harrison	Cadiz.
	Vermont	Chittenden	Hinesburg.
1967	Illinois	Champaign	Champaign.
		Christiana	?
		Fulton	Duncan Mills.
		Logan	Mount Pulaski.
		Mason	Boody.
		do	Havana.
		McLean	LeRoy.
		Menard	Atterberry.
		Piatt	Lodge.
		Pike	New Hartford.
		Sangamon	Mechanicsburg.
		Scott	Winchester.
		Vermilion	East Lynn.

Parasite release localities in Eastern United States, 1957–67—Continued

Species released, year, and State	County	Locality
Tetrastichus incertus—Continued		
1967 Indiana	Boone	Dover.
	do	Jamestown.
	Montgomery	Shannondale.
	do	Smartsburg.
New Hampshire	Berkshire	Ashley Falls.
	do	Sheffield.
	Hampshire	Hadley.
	do	Northampton.
	Merrimack	Concord.
	Strafford	Durham.
	Sullivan	Claremont.
	do	Langdon.
Vermont	Addison	Bridgeport.
	do	Ferrisburg.
	do	Shoreham.
Trichomalus inops		
1959 Delaware	Kent	Dover.
	do	Smyrna.
	New Castle	Middletown.
New Jersey	Burlington	Columbus.
Virginia	Accomack	Onancock.
1960 Delaware	Kent	Dover.
New Jersey	Burlington	Mount Holly.
1967 Arkansas	Mississippi	Keiser.



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